

Technology for

Alaskan Transportation

Winter 1987 — Volume 2
University of Alaska — Fairbanks
Transportation Technology
Transfer Program

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Using Geosynthetics In Road Design

The newly coined term "geosynthetic" refers to any artificial material used to reinforce earth structures. Although we are in the infancy of discovering the behavior of geosynthetics in the real world, many experts believe that using geosynthetics within soil structures will become as common as using steel to reinforce concrete.

Following the introduction of geosynthetics in the early 1970s, their use has increased rapidly. Many new materials were introduced into the marketplace. Most of these geosynthetics were plastics—primarily polypropylenes, polyethylenes and polyesters. Names such as geomembranes, geogrids, geodrains and geomats are now familiar to most engineers. Today, more than 50 manufacturers market hundreds of different geosynthetics in the United States.

While the uses of geosynthetics are limited only by the imagination of the engineer or contractor, the behavior of geosynthetics can be reduced to one of only four primary func-

tions: separation, tensile reinforcement, drainage and filtration.

Separation. One of the major causes of low-volume road deterioration is the contamination of the imported clean granular base materials with the fine-grained sub-grade soils. This is particularly true for low-volume roads where gravel base thicknesses are marginal or inadequate. Geosynthetics can be used effectively to separate these two materials. If a geosynthetic is used, the amount of select material needed is reduced by almost as much as the amount of material that would have been contaminated. This can amount to a foot or more in some locations. It can be even more significant in thin embankments used in low-volume and limited-life installations such as haul roads where high deflection under wheel loads is acceptable.

Drainage. Another major cause of road deterioration is excess water. Geosynthetics

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Funds for Alaska's Highways Chopped

Failure of the United States Congress to reauthorize the federal-aid highway program cut off new funding for Alaska's \$150 million annual highway improvement program. Major construction projects are awaiting a decision about which ones should use the \$45 million remaining from prior years.

Competing projects include the addition of new lanes to Dimond Boulevard (Anchorage), the construction of the final link of the South Fairbanks Expressway, and the con-

struction of the first section of the Geist Road Extension (Fairbanks). Small projects such as improving the intersection of the Parks and Glenn Highways (Mat-Su Valley), rebuilding the Whittier Ferry Terminal, providing frontage roads along the Richardson Highway (North Pole), and reconstruction of South Franklin Street (Juneau) are also caught in the bind.

Issues that blocked the U.S. Congress from

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University of Alaska—Fairbanks and the
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Using Geosynthetics

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are being used in edge drains and other drainage applications to separate the natural ground from the gravel, pipe or other drainage material. This eliminates the need for graded filters, which saves construction time and cost.

The use of geosynthetics in drainage applications has become quite sophisticated, resulting in some very innovative and economical solutions. Some very thick nonwoven geosynthetics can be used as drains by themselves; others consist of an open matrix on plastic sandwiched between two layers of a nonwoven geotextile. There are some very thick nonwoven geotextiles that will allow water to pass longitudinally through the material, thereby acting as a drain by itself. Some of these concepts have progressed to the point where an edge drain along a highway can be completely installed in a single pass of a piece of equipment.

Tensile reinforcement. Geosynthetics are also used to reinforce many different kinds of soil structures. In road construction across soft subgrade materials, a geosynthetic can be placed under the embankment to help spread the load on the subgrade. This limits lateral spreading of the embankment and rutting in the subgrade materials. Road embankments have been supported entirely on a single layer of geosynthetic across eight-foot-wide voids in test sections at the University of Alaska. However, significant deformation must take place before the geosynthetic carries the load.

There is considerable interest in using multiple layers of geosynthetics to improve the performance of embankments on very soft materials and over karst topography. The State of Alaska is using the concept in roads, and the French are using the concept under

buildings. Some applications under buildings have been proposed in Alaska. Experimental evidence supports the hypothesis that multiple layers of geosynthetics improve the performance of embankments under surface loading. Both experimental and theoretical evidence suggest that multiple layers of geosynthetics can be used to stabilize the edges of embankments and to limit slope failures. It also seems reasonable that geosynthetics could be used near the surface to minimize the longitudinal cracking that occurs in Alaska when thaw settlement makes the shoulders settle faster than the center of the road.

A considerable amount of experimental and theoretical evidence suggests that a single layer of geosynthetic at the bottom of the embankment will reduce lateral spreading and increase stability under load. There is virtually no experimental or theoretical background to guide the design of multi-layered systems to reinforce embankments across soft subgrades. This lack of information results in many installations based on the premise that it can't hurt, so let's try it.

Filtration. A filter is something that removes particulate matter from a fluid. By definition, a filter will become clogged and must be cleaned or replaced. Geosynthetics are used as filters only in silt fence applications. A slick woven geotextile is used, sometimes in conjunction with a geogrid reinforcement. The geotextile clogs and, in effect, becomes a dam. The height of the dam is determined by developing a pond which is just the right size to settle the solids. When the pond goes down during dry periods, the silt falls or is blown off the geotextile.

Information sources. There are several sources of information on geosynthetics for the practicing engineer. Sales representatives from the textile industry are still the widest

distributors of information and are always eager to discuss the state of the art with a potential client. They were also the first to fund research, and they still fund most of the research. The American Society of Testing Materials was the first nonbiased organization to attempt to coordinate research and provide a meaningful classification of properties. The Institute of Northern Engineering at the University of Alaska-Fairbanks and the Research Section of the Alaska Department of Transportation and Public Facilities are collaborating in geotextile research through a team led by Dr. Tom Kinney. The results of this ongoing research will be reported in future issues of *Technology for Alaskan Transportation*.

Every four years, there is an international conference on geosynthetics which will hereafter be sponsored by the International Geosynthetics Society (IGS). The next meeting will take place in New Orleans in February 1987. There is also a geosynthetics conference in this country every year sponsored by the Industrial Fabrics Association (IFA).

Several public organizations have produced documents giving the state of the art for particular applications. The most current publication for highway design is the Federal Highway Administration (FHWA) Design Manual produced in 1986. Perhaps the easiest way to learn more is to request a reprint of an article by Dr. Tom Kinney entitled, "Fundamentals of Geotextile Design." The article is quite general, but the reprint is still a good place to start (write the editor at the address that appears in the sidebar on page 3). There are also books on the subject. Finally, the Research Section of the Alaska Department of Transportation and Public Facilities is also a good source of information; call Dave Esch at (907) 474-2471. **AT**

News & Views

A Message From The Director

In June, Alaska joined 38 states participating in the Federal Highway Administration's Rural Technology Assistance Program (RTAP). This program provides a technical resource to those Alaskans facing the many challenges of meeting transportation needs. The goals of this program are to improve transportation expertise at the state and local level, and to encourage the use of cost-effective procedures and technology in Alaska's transportation systems.

This program is underwritten by a \$62,500 federal grant, which requires a like match from the Alaska Department of Transportation and Public Facilities (DOT&PF) and University of Alaska-Fairbanks (UAF). This program is housed in joint DOT&PF/UAF facilities in the Duckering Building on the UAF campus. I am the Chief of Planning and Research for DOT&PF. I'm supported by Dr. Nick Coetzee and Dr. Jan Botha from the University of Alaska Transportation Center.

Our operation is not a large one; my approach will be to do a few things well.

Our first focus has been on producing this newsletter to advertise our program. I would like our newsletter's calendar of events to become a comprehensive listing of transportation activities throughout the state. I welcome your comments and input.

We are planning to conduct 10 seminars our first year. We have already held three,

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Director's Message

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and four more are scheduled. Seminar subject areas will include administration, maintenance, operations, design and construction.

To minimize travel expenses and to reach the largest possible audience on a variety of subjects, most seminars will be held in Anchorage or Fairbanks. To better meet needs in other areas, we intend to establish a lending library of publications, video tapes and public domain software. We will be establishing an advisory committee to help select

and market materials that are most appropriate for the needs of Alaskans. Anyone interested in volunteering? We are looking for representatives from industry, and from state and local government.

I am very excited about this promising program. Statewide, Alaskans are being asked to provide efficient transportation services at less cost. I see this program providing the knowledge and tools to help accomplish that task.

John D. Martin

Continuing Education

Road Surface Management for Local Governments

This three-day course has been developed especially for local governments with responsibilities for paved, and chip and seal roads. This course will be offered in conjunction with the Alaska Transportation Forum in Anchorage this April to eliminate travel expense to the seminar for people already participating in the Forum.

Upon completion of the course, participants will understand basic road-surface management, resurfacing and rehabilitation concepts, techniques and objectives. They will be able to determine areas for making improvements in road-surface design, resurfacing, maintenance, rehabilitation and programming practices for their jurisdiction.

Participants will also learn to describe and evaluate how intergovernmental cooperation can result in improved road-surface management at lower costs. Finally, during the last afternoon, interested participants will be trained on how to train local personnel in the subjects covered in the preceding 2.5 days.

This course is scheduled for April 15-17 (the three days immediately following the Alaska Transportation Forum). For more information, call John D. Martin at (907) 451-5150 or Dr. Jan Botha at 474-7497.

Workshop on Current Trends in Pavement Design

Due to popular demand, the Transportation Technology Transfer Program will once again offer a workshop on current trends in pavement design. This two-day course will be offered in Anchorage sometime between March 16 and 20 1987. Instructors from the University of Alaska-Fairbanks and the DOT&PF Research Section will discuss the current state of the art in pavement design.

Work will include the latest pavement design guidelines and the current trend to mechanistic design procedures. Participants will learn how

these procedures work and how they can be applied. Each participant will have the opportunity to work with one or more design procedures. Call John D. Martin at (907) 451-5150 or Dr. Jan Botha at (907) 474-7497 for more information.

Seminar on Real Estate Acquisition for Local Public Agencies

This one-day seminar is designed for LPA (local public agency) personnel, state LPA coordinators, and Federal Highway Administration (FHWA) personnel who are responsible for implementing right-of-way programs. We will offer this course twice in March 1987. The seminar is appropriate for individuals responsible for conducting or supervising the acquisition of rights-of-way for federal-aid highways. The seminar introduces a manual entitled Real Estate Acquisition Guide that was developed in response to the need to increase the knowledge of LPA personnel regarding the application of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Special emphasis is given to implementing regulations from the federal perspective. Each participant receives a copy of the guide for use as a resource document.

Upon completion of the seminar, participants should understand the relationships among FHWA, state and LPA right-of-way programs. Participants will learn how to utilize the flexibility available in FHWA regulations for administering the real estate acquisition program. They will be able to identify opportunities for innovative approaches or practices in the area of real estate acquisition. Finally, each participant will receive a volume that answers regulatory questions that arise while administering a federal-aid, highway right-of-way program. This seminar will be offered twice: March 3 in Fairbanks and March 12 in Anchorage.

For more information, call John D. Martin at (907) 451-5150 or Dr. Jan Botha at 474-7497.

About Our Newsletter

Technology for Alaskan Transportation is a quarterly newsletter that informs local transportation people in government and industry of useful publications and services. The newsletter reports on useful research findings, new technology, and learning opportunities such as workshops, seminars and video tapes. To get on our mailing list or to contribute to the newsletter, contact:

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About Our Program

The goal of the Transportation Technology Transfer Program is to help local agencies obtain useful information and training related to local transportation needs. The program focuses on technology related to roads, bridges and public transportation. In addition to our newsletter, we will provide low-cost seminars and workshops, provide copies of useful technical reports upon request, and answer phone and mail inquiries related to transportation technology. If we don't have the answer, we will refer the question to a suitable specialist.

A variety of organizations support the Transportation Technology Transfer Program:

- the University of Alaska Transportation Center (UATC is an interdisciplinary center with participation from the schools of Engineering, Mineral Engineering, Management, and Agriculture and Land Resources Management).
- the Alaska Department of Transportation and Public Facilities
- the Federal Highway Administration

We invite you to address your questions or comments to any of the following people:

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Calendar of Events

We will be happy to include any relevant events you would like to publicize. Call the editor at (907) 474-6116. For more information on meetings outside of Alaska, call Marilou Demon at (202) 334-2934. For information about events in Alaska, call John D. Martin at (907) 451-5150 or Dr. Jan Botha at (907) 474-7497.

1987

March 3—Seminar on Real Estate Acquisition for Local Public Agencies. Fairbanks.

March 12—Seminar on Real Estate Acquisition for Local Public Agencies. Anchorage.

March 16-19—22nd Alaska Surveying and Mapping Conference. Fairbanks. Call (907) 243-5550.

April 14—4th Annual Alaska Transportation Forum. Anchorage.

April 15-17—Road Surface Management for Local Governments. Anchorage.

April 27-May 1—Katharine & Bryant Mather International Conference on Durability of Concrete. Atlanta, Georgia.

June 29-July 1—North American Conference on Microcomputers in Transportation. Boston, Massachusetts.

Funds Chopped

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extending this important program included raising the national speed limit of 55 miles per hour, and special funding for "demonstration projects." Even the most optimistic observers believe that these controversies and the organization of a new Congress will delay passage of a new bill until after March. National controversy over the federal highway program also includes possible changes to the apportionment formula, which could dramatically reduce Alaska's historically favorable share of federal highway funds.

Alaska's immense land mass, a major factor in the current formula, results in a return of five federal dollars to Alaska for every dollar Alaskan highway users pay into the Highway Trust Fund.

Revenues for this federal fund are derived through the collection of the nine cent per gallon tax on gasoline, the 15 cent tax on diesel fuel, and truck and tire taxes. The federal program contributes \$150 million annually, while Alaskans contribute about \$30 million annually to the trust fund.

Alaska uses assistance from the Highway

Trust Fund to: 1) pay contractors for the construction of highway improvements; 2) purchase rights-of-way and relocate utilities prior to construction; and 3) pay the salaries of engineers and planners who develop and oversee projects. Federal dollars, augmented by state matching funds, pay for most of the construction projects on Alaska's highway system each summer.

DOT&PF has responded to this situation by delaying all project funding while the department assesses the best way to spend the limited federal funding still on the books. Funding decisions must be made soon, however, if contractors are going to have the full benefit of Alaska's short summer construction season. With downturns in many sectors of the Alaskan economy, an inactive highway construction season is ill-timed. We can only hope that Congress will act quickly to reauthorize the federal-aid program at current levels to Alaska and resume the flow of highway funding. As state dollars for road projects dwindle, stable federal funding is essential to maintain and improve Alaska's highways. **AT**

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